Alchemy and Alchemists

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ALCHEMY AND ALCHEMISTS

BY PROF. JOHN READ

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" Everything possible to be believ'd is an image of truth."—
WM. BLAKE

The Scope, Origin, and Development of Alchemy

In a narrow sense, alchemy may be interpreted as the pretended art of transmuting the baser metals into silver and gold. In a wider sense, it was the chemistry of the Middle Ages : according to Liebig, indeed, alchemy was never anything but chemistry. In its broadest aspect, alchemy appears as a system of philosophy which claimed to penetrate the mystery of life as well as the formation of inanimate substances. Alchemy was thus a complex and indefinite mixture of chemistry, astrology, philosophy, occultism, magic, and other ingredients. A modern writer on this wider alchemy voices some of its claims in the following language [1] : " The operation of the Philosopher's Stone does not belong to the realm of pure chemistry. The method described with so remarkable a unity of doctrine excludes any idea of research or tentative procedure, and is incompatible with the abundant experimentation involved in modern chemistry, both organic and inorganic. In this method we see the working of an eagerness, an inspiration, and a fertilizing and generative element showing that the alchemists had surprised some secret of cellular life which, carried into the metallurgic field, produced effects unknown now. . . . It is not then from alchemy, as often stated, that

[1] G. de Givry, trans. J. C. Locke, *Witchcraft, Magic, and Alchemy*, London, 1931, pp. 374, 350.

modern chemistry derives, but actually from the erratic work of the Puffers."

Scientific chemistry has been called the outcome of man's attempts to produce gold artificially and to explain its occurrence in the earth's crust.[2] Thus, the origin of alchemy has often been associated with early references to the importance of gold, such as the representation on a tomb at Beni Hassan (*c.* 2500 B.C.) of the fusion and weighing of gold in ancient Egypt. It has been suggested also that the idea of transmutation arose out of the discovery of alloys simulating gold, to which a reference is made in the Leyden papyri (*c.* third century A.D.) found in a tomb at Thebes. There is ample evidence that the Egyptians were remarkably skilled in various arts based upon empirical chemical knowledge, such as metallurgy, enamelling, glass-tinting, and dyeing. For such reasons, Egypt, or *Khem*, the country of dark soil, the Hebrew " land of Ham," has often been pictured as the motherland of chemistry ; so that later this art of the dark country became known to Islam as *al Khem*, and through Islam to the Western world as *alchemy*.

The reputed Egyptian origin of alchemy is encouraged throughout the vast body of mediaeval alchemical literature by constant references to Hermes Trismegistos, the alleged father of the " Hermetic Art " and the patron of its practitioners, the self-styled " sons of Hermes." Hermes has been identified with Thoth, the Egyptian god of the healing art and of letters, and as such he may perhaps be excused for the 36,000 original writings which he was said to have contributed to alchemical literature ! Of these, the best known is the Smaragdine Table, or Emerald Table, of Hermes, consisting of a sequence of thirteen sentences or precepts which are frequently quoted in mediaeval alchemical writings. These were often regarded as embodying either the fundamental principles of alchemy or the secret of transmutation, according to the predilections of the com-

[2] E. J. Holmyard, *The Great Chemists*, London, 1928, p. 2.

mentator. A work ascribed to Albertus Magnus states that the original emerald slab, upon which the precepts were inscribed in Phœnician characters, was discovered in the tomb of Hermes by Alexander the Great.

In recent years Egypt has found a rival in China, as the possible original home of alchemy. According to Waley,[3] the ancient Chinese had inherited from remote ages a belief in the life-giving and rejuvenating properties of jade, pearl, cinnabar, and other materials. In extant alchemical treatises of the fourth century A.D., Pao P'u Tzu discriminates between three kinds of alchemy: (1) the preparation of a liquid gold, producing longevity; (2) the production of artificial cinnabar, the "life-giving" red pigment, for use in gold-making; (3) transmutation of base metals into gold. In the tenth century, exoteric alchemy (*wai tan*) merged into esoteric (*nei tan*), the "souls" or "essences" of mercury, sulphur, lead, etc., bearing to the common metals the same relationship as the Taoist, adept, or perfected man, bears to common mortals. A further evolution had been reached at the end of the eleventh century, the transcendental metals having become identified with various parts of the human body.

These leading ideas are so strongly reminiscent of the tenets of Western alchemy that a common origin has been sought for the two schools of thought. According to von Lippmann, alchemy proper reached China from the West in the eighth century through the medium of Arab trading ships. On the other hand, it has been suggested that alchemy first arose in China from the philosophy of Taoism, and then spread westwards; in particular, it has been stated that the idea of the Philosopher's Stone as an elixir of life was derived from the Chinese.[4]

[3] A. Waley, *The Travels of an Alchemist: the Journey of the Taoist Ch'ang-Ch'un from China to the Hindukush at the Summons of Chingiz Khan* (translation with Introduction), London, 1931.

[4] A. Waley, "Notes on Chinese Alchemy," in the *Bulletin of the School of Oriental Studies*, London Institution, 1930, vol. vi. part 1; see also O. S. Johnson, *A Study of Chinese Alchemy*, Shanghai, 1928.

Although there is an antecedent possibility that alchemy arose in Babylonia, the home of astrology and magic in the ancient world, it is generally assumed that its roots are to be sought in Egypt; and that later, at Alexandria, Egyptian practice made effective contact with Greek scientific thought. Greek knowledge and theories were in turn transmitted to Islam; fresh material came in from other countries, including perhaps India and China; and eventually the accumulated knowledge of the Muslim chemists was disseminated throughout western Europe, mainly by way of Spain.

Some of the more prominent features in the early development of alchemy have been aptly summarised by Holmyard [5] in the following words:

"Although there are dissentients, it is commonly believed that chemistry arose in the early years of the Christian era, as a result of the fusion of Egyptian metallurgical and other arts with the mystical philosophies of the Neo-Platonists and Gnostics. Unluckily, the Neo-Platonists regarded matter as the principle of unreality or evil, from which the disciple should attempt to detach himself, while the Gnostics cared little for the phenomena of the sensible world, being much more anxious to attain to a knowledge of the invisible cosmos. It is significant for the later history of the science that one of the earliest chemical writers, Zosimos the Panopolitan, was a Gnostic, while the Neo-Platonic conceptions of sympathetic action, action at a distance, the distinction between occult and manifest properties, the influence of the stars, and the mystical powers of numbers, all permeate chemistry from its beginnings at the time of Plotinus until the close of the seventeenth century. It would, indeed, scarcely be going too far to say that some of these ideas are with us still: nitrogen is manifestly inert but occultly active, and the structure of the atom is ultimately a matter of the relations between numbers."

Alchemy, like modern science, had its theories, although

[5] E. J. Holmyard, *Nature*, vol. cxxiii, p. 520 (1924).

these were often vague, ill defined, and subject to interpretations suiting the whims of the interpreter. The fundamental physical theory of alchemy was that of the Four Elements, or "simple bodies." This is usually ascribed to Aristotle (*c.* 350 B.C.), but the fundamental idea is said to have been recognised in both India and Egypt as early as 1500 B.C. "It is one of those crude physical theories which is enunciated and accepted by races the most diverse in character, country, faith, destiny. There is great oneness in the human mind in the matter of broad principles in crude cosmical ideas." [6]

Briefly, the theory postulated the existence, as abstract entities, of four elementary properties or qualities of bodies: these were the hot, the cold, the moist, and the dry. The four material elements—earth, air, fire, and water—were pictured as originating by pair-wise conjunctions of the four elementary qualities, as indicated diagrammatically in Fig. 1.

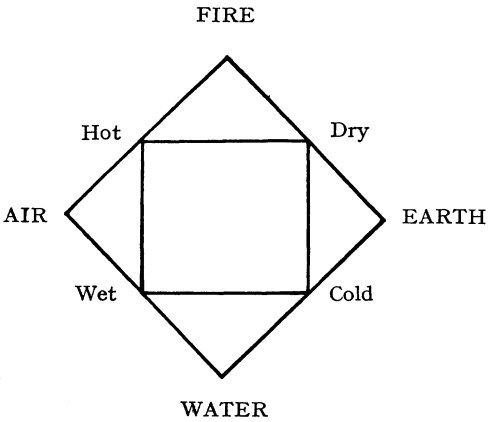

FIG. 1.—THE FOUR ELEMENTS

All bodies were held to be composed of the four elements in different proportions. As a corollary, one body could

[6] G. F. Rodwell, *The Birth of Chemistry*, London, 1874, p. 27.

be changed, or transmuted, into another by altering the proportions of the elements present; further, this supposed transmutation was correlated with the idea of a *prima materia*, or primordial matter, from which all things came and to which they all reverted.

The theory may be illustrated by quoting a simple example of a supposed transmutation. Water is wet and cold; when the cold is expelled through the application of heat, the water changes into air (*i.e.* an invisible vapour), which is wet and hot. Earth, water, and air apparently typified the solid, liquid, and gaseous states of matter, while fire typified combustibility and possibly energy.

The practice of alchemy was strongly influenced throughout a period of some fifteen centuries by a belief in the existence of a potent transmuting agent and universal medicine. This is referred to in alchemical writings under many names, such as the Philosopher's Stone, the Elixir Vitae, the Grand Magisterium, Magistery, or Elixir, and the Red Tincture. It has already been said that the general idea of transmutation formed an integral part of the theory of the four elements. Beyond this, a belief in the possibility of a specific transmutation of base metals into silver and gold was no doubt fostered by a variety of experimental observations, such as the production of silver from the lead of galena and the preparation of alloys bearing a superficial resemblance to gold. The idea of the Philosopher's Stone may have arisen from the Alexandrian and Neo-Platonic belief in magic; it played a part also in a supposed analogy between the alchemical doctrine of transmutation and the mystical doctrine of the regeneration of man. The descriptions of the perfect stone, or elixir, are many and various. In some of them it was depicted as a heavy, glittering powder, which melted without producing smoke. The powder was red or white, in accordance with its power of converting the base metals into gold or silver when "projected" upon them. Van Helmont, in 1618, described it

" of colour, such as is in Saffron in its powder, yet weighty, and shining like unto powdered Glass " ; Helvetius also, as late as 1667, said that the Tincture resembled glass or pale sulphur.

The Alexandrian era, during which the idea of the Philosopher's Stone appears to have been conceived, came to an end in the middle of the seventh century. The succeeding age, until the thirteenth century, witnessed a domination of alchemy by the Muslims. The writings of this period give evidence of notable advances, not only in alchemy, but also in mathematics, astronomy, and medicine. The practical achievements of alchemy, as described in the works of Geber, Rhazes, Avicenna, and others, were enriched by the preparation of many new substances and by the skilful application of such processes as cupellation, reduction, distillation, calcination, and sublimation. Many of these writings are ascribed to Geber, or Jabir, a somewhat shadowy figure who appears to have flourished about the end of the ninth century ; in them the celebrated sulphur-mercury theory of the metals is expounded.

Aristotle had supposed that earth and water gave rise, respectively, to smoky and vaporous exhalations ; the earthy smoke consisted of earth in process of change to fire, and the watery vapour was water undergoing conversion into air. Refractory stones and minerals consisted mainly of the earthy smoke, and fusible metals were formed from the watery vapour. Geber postulated an intermediate formation of sulphur and mercury from the exhalations, in the interior of the earth. Finally, sulphur and mercury, by combining in different proportions and in different degrees of purity, gave rise to the various metals and minerals. The influence of this view of the constitution of metals may be traced in the leading theories of chemistry right down to the time of Lavoisier.

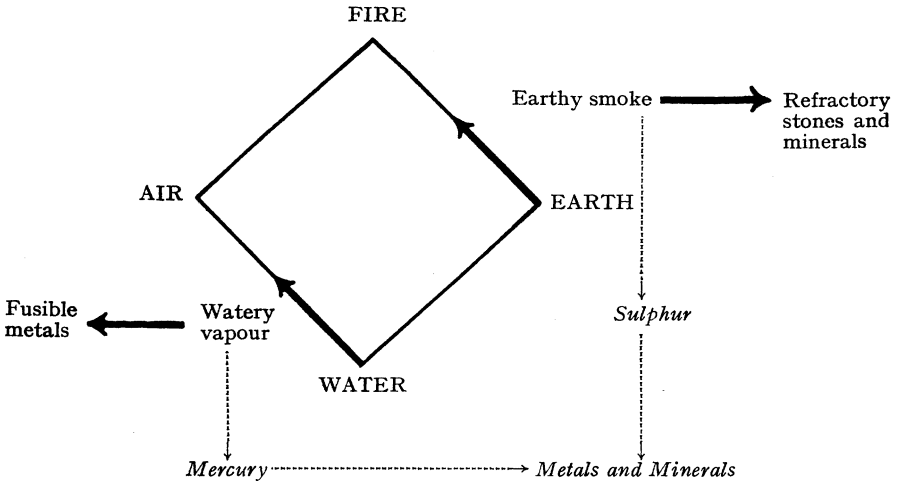

FIG. 2.—THE SULPHUR-MERCURY THEORY OF THE ORIGIN OF METALS

(Geber's additions to the Aristotelian scheme are shown in italics)

" *Alchimy* is a Science," wrote Roger Bacon in his *Speculum Alchemiæ*,[7] " teaching how to transforme any kind of mettall into another: and that by a proper medicine, as it appeareth by many Philosophers Bookes. *Alchimy* therefore is a science teaching how to make and compound a certaine medicine, which is called *Elixir*, the which when it is cast upon mettalls or imperfect bodies, doth fully perfect them in the verie projection. . . . The natural principles in the mynes, are *Argent-vive*, and *Sulphur*. All mettalls and minerals, whereof there be sundrie and divers kinds, are begotten of these two: but I must tel you, that nature alwaies intendeth and striveth to the perfection of Gold: but many accidents coming between, change the mettalls. . . . For according to the puritie and impuritie of the two aforesaid principles, *Argent-vive*, and *Sulphur*, pure and impure mettalls are ingendred."

A representation of Thomas Aquinas appearing in a

[7] The quotation is from the English translation, the *Mirror of Alchimy* of 1597.

work[8] published in 1624, forms an apt illustration of Roger Bacon's description of thirteenth-century alchemy. It contains a pictorial representation of the natural production of metals in the bowels of the earth, from exhalations marked with the signs of sulphur and mercury ; above, on the crust of the earth, an alchemist is engaged in an experimental attempt to make the same metals artificially. The accompanying Latin epigram states that " from mercury mingled with its own sulphur, art, even as nature, brings forth all metals."

The mercury and sulphur of this theory were not held to be identical with the common substances bearing these names. It was already known to Geber that under experimental conditions these two substances gave rise to the " red stone " known in nature as cinnabar (*i.e.* mercuric sulphide), and not to metals. The names stood rather for combinations of properties or qualities. The view was widely held among alchemists that when ordinary mercury and sulphur were divested of their grosser (physical) properties, they yielded " philosophical " mercury and sulphur —that is to say, the mercury and sulphur of the theory. Aristotle's theory provided four fundamental causes of the physical properties of substances, and it may be said that broadly the mercury-sulphur theory supplemented the older theory by providing two fundamental causes of chemical properties. Essentially, mercury appears to have stood for metallicity and sulphur for inflammability. In philosophical sulphur is to be discerned, indeed, the germ of the phlogiston theory of the seventeenth and eighteenth centuries.

Naturally, throughout the centuries during which it held sway, the mercury-sulphur theory was interpreted in manifold ways. A slight acquaintance with alchemical literature is sufficient to furnish some idea of the labyrinthine theoretical and practical schemes which the writers constructed

[8] Reproduced in *Viridarium Chymicum*, Frankfurt, 1624, from Michael Maier's *Symbola Aureæ Mensæ Duodecim Nationum*, Frankfurt, 1617.

by associating this theory with the conception of the Philosopher's Stone and with many other ideas derived from the doctrines of astrology, mystical theology, magic, and the like. Thus, the "mercury of the philosophers"—the essence or soul of ordinary mercury, divested of the gross physical properties represented by earth, air, fire, and water—was often identified with the *prima materia* of the Ionian philosophers. Strip mercury of these qualities, and it yields the one primitive matter; impose the appropriate new qualities upon the primitive matter, and the desired new substance is attained.

Although the precepts of Hermes Trismegistos have sometimes been dismissed as meaningless, they appear to incorporate some of the fundamental ideas of alchemy. "What is below is like that which is above, and what is above is like that which is below, to accomplish the miracles of one thing; and as all things were produced by the one word of one Being, so all things were produced from this one thing by adaptation," run the second and third precepts, which are essentially a statement of the alchemical doctrine of the unity of all things. A broad view of alchemy discloses that all forms of matter are considered to have a common origin, and a common soul or essence which alone is permanent; the outward form, or body, is merely the temporary abode of the imperishable soul; substances are produced by evolutionary processes, and are capable of undergoing transmutation.

Practical alchemy was thus a branch of a comprehensive philosophical system, and the experimental attempts of the true adepts to transmute metals were carried out with the aim of adducing a material proof of that system. The worldly-minded seekers after gold, sometimes disdainfully known as "souffleurs," or "puffers," were regarded as "outsiders" by the alchemical cognoscenti.

An attempt has been made in Fig. 3 to summarise one of the simplest of the many schemes of transmutation which

are expounded with varying degrees of unintelligibility in alchemical literature :

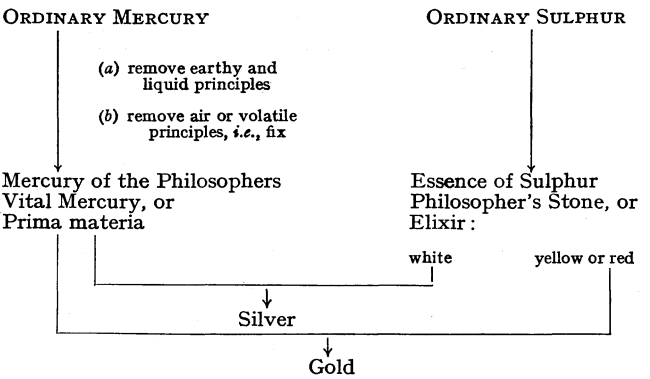

FIG. 3.—DIAGRAMMATIC REPRESENTATION OF A SCHEME OF TRANSMUTATION

The earthy and watery principles are removed from ordinary mercury, and it is then fixed by being deprived of its airy or volatile principle : " Separate the earth from the fire, the subtle from the gross, acting prudently and with judgment," says the seventh precept of Hermes. The resulting quintessence of the metals—possibly " the father of all perfection throughout the world," of the fifth precept —is then heated with a quintessence derived from ordinary sulphur in a fundamentally similar way, the operation being conducted under auspicious conditions in an incubatory or brooding furnace, shaped like an egg. The quintessence of sulphur here indicated is one of the many guises assumed by the Philosopher's Stone : if white it yielded silver, if yellow or red it gave gold. The final operation is possibly the union of " the powers of things superior and inferior," denoted in the eighth precept of Hermes.

Incidentally, the brooding furnace recalls the philosopher's egg ; this was regarded by the alchemists as a symbol of creation, and was derived from Babylon and

Egypt; the Greeks sometimes depicted it as a container of the four elements.

The alchemical doctrine of the unity of all things led to the essential identification of the Philosopher's Stone with the Elixir of Life. The medicine of the metals became also the medicine of man: "then will that Medicine heale all manner Infirmitie, and turne all Mettalls to Sonne and Moone [9] most perfectly," wrote Ripley in the epistle to his *Compound of Alchymie*. Sulphur and mercury were then recognised as the counterparts of man's soul and spirit. Later, the original sulphur-mercury theory was extended by the addition of salt (or magnesia) as the third member of the so-called *tria prima* or three "hypostatical principles." Salt represented materially the principle of uninflammability and fixidity, and mystically the body of man. The relationships of the *tria prima* were thus as follows:

Sulphur	*Mercury*	*Salt*
Inflammability	Metallicity, fusibility, volatility	Uninflammability and fixidity
Volatile, but undergoes a change in the fire	Volatile, and unchanged in the fire	Found in the ashes
Soul	Spirit	Body

These relationships, presented in many forms, are among the most familiar features of alchemical literature. Thus, "when a rectified aqua vitae is kindled," wrote Basil Valentine, "its mercury and sulphur separate, the sulphur burns quite vividly, for it is pure fire, and the delicate mercury flies into the air, and returns to its original chaos." As an example of another type, the quaint *Book of Lambspring*, which was included in the *Musæum Hermeticum* of 1625, contains an illustration of two fishes swimming in the sea: "the Sea is the Body, the two Fishes are Soul and Spirit." Another illustration depicts a deer and a unicorn in a forest,

[9] That is, silver and gold; see Elias Ashmole's *Theatrum Chemicum Britannicum*, London, 1652, p. 116.

and the accompanying interpretation states that " in the Body [the forest] there is Soul [the deer] and Spirit [the unicorn] . . . he that knows how to tame and master them by Art, to couple them together, and to lead them in and out of the forest, may justly be called a Master, for we rightly judge that he has attained the golden flesh."

The linking of such alchemical ideas with theological doctrine is well illustrated by the following rendering [10] of the prayer of " the learned and rare Philosopher of our Nation," George Ripley (1415-1490), canon of Bridlington, in the prologue to his popular work, *The Compound of Alchymie . . . Conteining twelve Gates*: " O Unity in the substance, and Trinity in the Godhead . . . As Thou didst make all things out of *one* chaos, so let me be skilled to evolve our microcosm out of *one* substance in its three aspects of Magnesia, Sulphur, and Mercury." Ripley, indeed, pictured the Stone as a triune microcosm.

The theory of the *tria prima* was developed particularly by Paracelsus (1493-1541), who introduced a new era of iatro-chemistry, or alchemy in the service of medicine. " Marvellous Paracelsus, always drunk and always lucid, like the heroes of Rabelais," expounded with great vigour, seasoned with venom, the view that the chief object of the alchemist should be to aid the apothecary and the physician, rather than to make gold. His great achievement for alchemy was to release it from the narrow and sordid domination of the " multipliers " and " bellows-blowers " ; he gave it a new orientation and endowed it with a fresh stimulus. In 1520, Luther symbolised the freeing of religion from the trammels of orthodoxy by burning the papal bull at Wittenberg ; five years later, Paracelsus' public burning of the works of Galen and Avicenna before the burghers and physicians of Basel was a similar gesture in the realms of medicine and alchemy.

[10] A. E. Waite (ed.), *The Hermetic Museum*, London, 1893, vol. ii, p. 319.

Liberated from its main obsession of gold-making, alchemy changed imperceptibly, during the next few generations, into chemistry. The work of Libavius (1540-1616), van Helmont (1577-1644), and Glauber (1604-1668) contained numerous valuable additions to the practice of chemistry. In 1595 Libavius published his celebrated *Alchymia*, which served as an authoritative and comprehensive text-book to his immediate successors; van Helmont was the first to recognise gases as distinct substances; and Glauber added much to the existing knowledge of metals, acids, and salts. These chemists, like their great successor Robert Boyle, shared the alchemical belief in transmutation, but they no longer regarded gold-making as their main goal. Alchemical mysticism and obscurantism were gradually fading away, and although alchemical traditions lingered on into the early eighteenth century, the long age of alchemy virtually ended with Robert Boyle's abolition of the systems of the four elements and the three hypostatical principles and his introduction of the modern chemical idea of an element, as expounded in his celebrated book, *The Sceptical Chymist*, published in London in 1661.

The Literature of Alchemy

Probably the oldest writing extant of alchemical interest is the Papyrus Ebers, which was found in a tomb at Thebes about 1862. This "oldest book in the world" consisted, when discovered, of a roll of papyrus twelve inches wide and sixty-eight feet long. It dates from about 1550 B.C., and portions of its contents may be some twenty centuries older. It is mainly a collection of prescriptions, and Ebers claimed it as one of the "Hermetic Books" of ancient Egypt, the authorship of which was ascribed to Hermes or Thoth (sometimes identified with the deified Athothis of 3400 B.C., or with Imhotep, both of whom excelled in the art of healing).

There are also various Babylonian tablets, dating from

the seventh century B.C., which deal with formulae used by workers in glass and metals.[11] Apart from the general chemical interest of such literary remains of the ancient civilisations, the written records of Western alchemy begin with Greek texts composed at Alexandria. According to Suidas, Zosimos of Panopolis (*c.* 300 A.D.) produced an alchemical encyclopaedia of some twenty-eight books; a number of his reputed writings, contained in the Bibliothèque Nationale at Paris, were translated by Berthelot. The dates of the surviving Greek manuscripts are uncertain: probably few are earlier than the tenth or eleventh centuries. Some of them are the work of authentic authors, but others are attributed to Hermes, Isis, Democritus, Moses, Mary the Jewess, and other exalted personages. "They offer us the most bizarre picture of Gnostic theory intermingled with chemical fact, ecstatic visions, descriptions of apparatus, and injunctions to the reader to keep the secret of the Art from the vulgar . . . As we pass to those chemists who succeeded Zosimos—Pelagius, Synesius, Heliodorus, Olympiodorus and others—speculation and occult theory grow ever wider apart from experimental fact, and at length we encounter the conception of a philosopher's stone." [12]

Many alchemical manuscripts written in Arabic and Persian, in the eighth century and later, are preserved in the great libraries of the world, and occasional discoveries of uncatalogued manuscripts of this kind are still being made in Egypt and the adjacent countries. With the close of the Alexandrian era (*c.* 650) and the rise of Islam, many of the Greek writings on alchemy, mathematics, medicine, etc. were translated into Arabic. Between the eighth and the thirteenth centuries great schools of learning arose at Baghdad, Damascus, Cordova, Toledo, and other centres of Muslim culture. In due course, translations from the Greek

[11] R. C. Thompson, *On the Chemistry of the Ancient Assyrians*, London, 1925.

[12] E. J. Holmyard, *Makers of Chemistry*, Oxford, 1931, pp. 35, 39.

were supplemented by the indigenous writings of such Muslim savants as Geber (" the greatest chemist of Islam "), Rhazes (" the Persian Boyle "), and Avicenna (" the Aristotle of the Arabians "). Through the eventual translation of such writings into Latin, much of the academical knowledge of the Arabs, the Greeks, and the ancient civilisations was transmitted to western Europe. Geber's *Book of Seventy* and *Book of Mercy* are known in both versions, Arabic and Latin ; but the majority of the Latin works attributed to him, including the celebrated *Sum of Perfection*, have no known Arabic originals, so that their authenticity is not proven.

European scholars first became interested in the translation of alchemical texts early in the twelfth century ; such translators as Gerard of Cremona, Michael Scot, Robert of Chester, Adelard of Bath, and Hermann of Carinthia were thus instrumental in making known to western Europe the accumulated wisdom of the Muslim world. " Quand la domination arabe se trouva anéantie en Espagne," remarks Figuier, "l'alchimie avait déjà conquis sur le sol de l'Occident une patrie nouvelle." The translations of this period were done into Latin, and this language was the usual medium in which the adepts embodied, or embedded, their observations and ideas during the next five centuries. Boyle's *Sceptical Chymist* (1661) marked alike the decline of alchemy and the gradual abandonment of Latin, in favour of their native tongues, by the exponents of the new chemistry.

Besides the almost incredible mass of printed alchemical literature which has come down to us, multitudes of unprinted manuscripts have survived, and these are being systematically catalogued under the auspices of the Union Académique Internationale.[13] One of the oldest and most

[13] J. Bidez *et al, Catalogue des manuscrits alchimiques grecs* ; Mrs. D. W. Singer, *Catalogue of Latin and Vernacular Alchemical Manuscripts in Great Britain and Ireland dating from before the XVI Century*, Brussels, 1928.

interesting alchemical manuscripts in the British Museum is a thirteenth-century transcript, in Latin, of Roger Bacon's *Speculum Secretorum*. An English manuscript of the fifteenth century, in the same collection, states that "Mercury is modre of alle metalls with sulphur and with the rede stoone . . . and in nature he is hoote and moyste."

As an example of an early printed work on alchemy, we may select the *Summa Perfectionis Magisterii* and certain associated works attributed to Geber. These were printed in company with Roger Bacon's *Speculum Alchemiæ* and four other works, including the *Tabula Smaragdina Hermetis*, in such editions as those dated 1541 (Nuremberg) and 1545 (Berne). The Geber texts here concerned can be traced back through the first printed edition of about 1481 to manuscript versions of the early thirteenth century; they were embellished in the Berne edition with sixteen bold woodcuts of furnaces and other alchemical apparatus. This edition was translated into English in 1678 by Richard Russell, under the title: "The Works of Geber, The Most Famous Arabian Prince and Philospher." The treatise recognises the existence of three natural principles of metals, under the names sulphur, arsenick, and argentvive. The allusion to sulphur as "a fatness of the Earth" is suggestive of the later statement of Paracelsus that "the life of Metalls is a secret fatnesse, which they have received from Sulphur." Arsenick "needs not be otherwise defined than Sulphur," save that it is a tincture of whiteness instead of redness. Argentvive, or mercury, "is a viscous Water in the Bowels of the Earth . . . It is also (as some say) the Matter of Metals with Sulphur." The work contains much accurate detail of an observational and practical kind, the properties of metals, for example, being described with much felicity: "We signifie to the Sons of Learning, that Tin is a Metallick Body, white, not pure, livid, and sounding little, partaking of little Earthiness; possessing in its Root Harshness, Softness, and Swiftness of Liquefaction, with-

out Ignition, and not abiding the Cupel, or Cement, but Extensible under the Hammer."

Among the early printed books dealing with severely practical aspects of alchemy are Brunschwyg's *Buch zu Distillieren* and Agricola's *De Re Metallica*. The first of these was one of the earliest works of chemical interest to appear in the German language. It contains a comprehensive account of the process of distillation and its applications. The numerous bold woodcuts with which it is adorned were the first attempts at representing chemical apparatus and manipulations in this way. The first edition appeared in 1512; the second, augmented, edition of 1519 is a noble volume containing 330 folio sheets, beautifully printed in Gothic letter, in double columns. This rare work is sometimes encountered in the original German pigskin binding, with brass bosses and clasps, once carrying leathern thongs which have long since disappeared. "Laus deo et honor," wrote the author as he laid down his pen: "Here endeth this book, happily printed and brought to a close in the Imperial city of Strassburg by Johann Grüninger on the eve of St. Adolphus in the year of our Lord 1519."

De Re Metallica, the standard mediaeval work on mining and metallurgy, was first published at Basel in 1556. The author, George Bauer, was physician to the miners of Joachimstal. It is a handsome book, of folio size, profusely illustrated with woodcuts; these afford an admirable idea of the processes and machinery described in the text, and at the same time they are spirited and artistic. The contents are not wholly metallurgical, as there are sections on assaying, cupellation, and the preparation of salts and other substances. A German translation was issued from Basel in 1621; the only English translation is that of H. C. Hoover (later President Hoover) and Mrs. L. H. Hoover, published in London in 1912.

The two works which have just been mentioned are intelligible text-books giving clear practical directions for hand-

ling apparatus and machinery and for carrying out definite chemical and metallurgical operations. They differ therefore from the typical literature of alchemy, which was characterised by its symbolism and mysticism ; its addiction to allegory and cryptic expression ; and its wide use of an unintelligible jargon. Many of the alchemical treatises were either anonymous, " as befits veiled masters," or written under high-sounding pseudonyms, such as Basil Valentine, " the valiant king." " All haile to the noble Companie of true Students in holy *Alchimie*," exclaims the author of *The Hunting of the Greene Lyon*,[14] " whose noble practise doth hem teach to vaile their secrets with mistie speach."

In ancient Egypt a knowledge of chemical secrets was the guarded prerogative of priests and kings; and at a later date the " sons of Hermes " were wont to enmesh their " precious pearls " of alchemy in a web of enigma, cryptogram, and obscure expression which surpassed in unintelligibility their patron's famous Smaragdine Table. The symbolism of alchemy dates from very early times. The representation of iron by the shield and spear of Mars, of copper by the looking-glass of Venus, of quicksilver by the caduceus of Mercury, and so on, was a consequence of the Chaldean practice of associating the familiar heavenly bodies with metals and with human organs and destinies. Thus Chaucer writes, in *The Tale of the Chanons Yeoman* : [15]

> " *Sol* Gold is, and *Luna* Sylver we threpe,
> *Mars*, Iron, *Mercury*, Quicksilver we clepe :
> *Saturnus* Lede, and *Jupiter* is Tynne,
> And *Venus* Copper, by my father kynne."

Owing perhaps to their abhorrence of Greek paganism, the Arabs were very sparing in their use of such symbols, and it was not until alchemy had become established in western Europe that its practitioners developed the com-

[14] E. Ashmole, *Theatrum Chemicum Britannicum*, London, 1652, p. 278.
[15] *Ibid.* p. 236.

prehensive code which permeates mediaeval alchemical writings. One of the earliest of the alchemists to make an extensive use of symbolism was Nicolas Flamel (1330-1418), the most celebrated of the French adepts, and, according to tradition, one of the most successful of the gold-makers. The elaborate frescoes which decorated the Charnier des Innocents in Paris until early in the nineteenth century were said to have been fashioned according to images or figures painted in the mysterious "manuscript of Abraham the Jew," a study of which led Flamel to master the great secret.

Among these figures were a serpent crucified; a fair flower on a mountain top, shaken by the north wind; a fair rose-tree growing against a hollow oak near a fountain of pure white water; and a king with a faulchion, who caused his soldiers to slay before him many infants. "These infants' blood being gathered up by other soldiers, was put in a great vessel wherein Sol and Luna came to bathe themselves. And because this history seemed to represent the destruction of the Innocents by Herod . . . I placed in their churchyard these hieroglyphic figures of this learning." To his great relief, Flamel eventually discovered that infants' blood signified merely the mineral spirit of metals. On 25th April, 1382, at five o'clock in the afternoon, Perrenelle his wife only being present, Flamel made projection of his red stone upon mercury, which, he says, "I truly transmuted into almost as much gold, much better, indeed, than common gold, more soft also, and more pliable." [16]

The reports of successful gold-making by Flamel and other adepts who were held to have achieved the great secret led in due course to the appointment of court alchemists. James IV of Scotland was one of the many princes who dabbled in alchemy with the twofold object of acquiring wealth and healing disease. His chief assistant in these studies was John Damian, a man "of pleasing

[16] A. E. Waite, *Lives of Alchemystical Philosophers*, London, 1888, p. 107.

address and great ingenuity," who in 1504 was made Abbot of Tungland in Galloway, so that he might secure the necessary leisure for his alchemical projects. The new ecclesiastical dignitary preferred the smells of his laboratory to the odour of sanctity, and feared the effect of the laboratory smoke upon his costly religious vestments; for William Dunbar, the poet, who had cast longing eyes upon the vacant appointment at Tungland, wrote acidly of him :

> " Unto no mess pressit this prelat,
> For sound of sacring bell nor skellat . . .
> On him come nowthir stole nor fannoun,
> Ffor smowking of the smydy."

Numerous entries in the accounts of the Lord High Treasurer of Scotland during the first decade of the sixteenth century show that these were busy days in the alchemical laboratories at Stirling and Cambuskenneth. The following typical items may be quoted in illustration : in 1503, " the penult day of March, to ane boy that kepit the furnes fire, by the Kingis command, vj s. viij d. " ; in 1507, " xxix September, for aqua vite to the quinta essencia, vij s. " ; " xxij December, to the smyth of Cambuskinneth for making of ane irn kist for quinta essencia, xiiij s. " ; " xxxj December, payit to Andro Aytoun quhilk he laid doun for wod, colis, and Caldwellis wage for quinta essencia, v li. xix s. x d."

Damian was a pioneer of flying, and besides conducting alchemical experiments in Stirling Castle he attempted to take off from its lofty battlements for a flight to Paris. This remarkable venture was the first serious flying experiment ever made in Scotland—if not, indeed, in the whole history of experimental flight. It is described as follows by Bishop Lesley,[17] in a manuscript history of the period which he gave to Mary Queen of Scots in 1571 :

[17] J. Lesley, *The History of Scotland from* 1436 *to* 1561, Edinburgh, 1830, p. 76 (from a manuscript given to Mary Queen of Scots in 1571 by the author).

"The xxvij day of September [1508] the Archebischopp of Sanct Androis and the Erle of Arrane wer send ambassadouris to the King of France, and past be sey, for obteaning of certane privilegeis for the commone weill of the realme, speciallie towart the garde and gentlemen of armes in France, and the weill of merchantis.

"This tyme thair wes ane Italiane with the King, quha wes maid Abbott of Tungland, and wes of curious ingyne. He causet the King believe that he, be multiplyinge and utheris his inventions, wold make fine golde of uther mettall, quhilk science he callit the quintassence; quhairupon the King maid greit cost, bot all in vaine. This Abbott tuik in hand to flie with wingis, and to be in Fraunce befoir the saidis ambassadouris; and to that effect he causet mak ane pair of wingis of fedderis, quhilkis beand fessinit apoun him, he flew of the castell wall of Striveling, bot shortlie he fell to the ground and brak his thee bane; bot the wyt thairof he asscryvit to that thair was sum hen fedderis in the wingis, quhilk yarnit and covet the mydding and not the skyis."

Damian's explanation of hen's feathers having an affinity with the midden (and those of eagles with the skies) bears the impress of the doctrine of signatures, and is in line with the alchemical conception of sympathy.

Dunbar celebrated this mishap with great gusto in a satirical poem entitled "The Fenyeit Freir of Tungland, how he fell in the myre fleand to Turkiland." We can understand the sentiments, if not the language,[18] of the following typical lines:

"Me thocht seir fassonis he assailyeit,
To mak the quintessance, and failyeit;
And quhen he saw that nocht availyeit,
A fedrem on he tuke,
And schupe in Turky for to fle . . .

[18] *Fenyeit*, feigned or false; *skellat*, little bell; *fannoun*, scarf worn on left arm of a priest officiating at mass; *seir fassonis*, various fashions; *fedrem*, a coat of feathers with wings; *schupe*, tried; *schewre*, tore or shore; *schene*, bright; *glar*, mud or dirt.

He schewre his feddreme that was schene,
And slippit owt of it full clene,
And in a myre, up to the ene,
Amang the glar did glyd."

Notwithstanding such jibes, the man of metals had shown himself to be also a man of mettle, deserving of the lucky star which had let him down lightly with nothing worse than a broken thigh-bone. The normal fate of the unsuccessful court alchemist was death by hanging, in tinsel robes on a gilded gallows. Even the successful adept was liable to suffer through an imprudent demonstration of his transmutative process. Thus, Alexander Seton, the so-called " Cosmopolite," was immured in a dungeon and tortured by the Elector of Saxony, whose cupidity he had aroused ; and although he succeeded in escaping in a dramatic manner, this " chief martyr of alchemy " died in 1604 as a result of the inhuman treatment he had received.

We encounter a typical alchemical work of the allegorical kind in *Pretiosa Margarita Novella De Thesauro, Ac Pretiosissimo Philosophorum Lapide*, an elegant duodecimo volume printed at Venice in 1546. This work, perhaps because it is concerned so closely with the Elixir of Life, has kept its youth in an amazing way : the delicate, diminutive type of the copy in the St. Andrews collection is as fresh as that of a modern book, and the paper shows scarcely a stain, except at the edges. This " new pearl of great price " expounds the history and principles of the " divine art," the nature of metals, the operation of the Philosopher's Stone, and many other alchemical ideas, as culled from the writings of Arnold of Villanova, Raymond Lully, Rhazes, Albertus Magnus, and Michael Scot. The accompanying woodcuts are noteworthy. One of them offers an emblematic illustration of the four elements of Aristotle, in which earth, water, air, and fire are represented by a bear, a dragon, a bird, and an angel, respectively. Fourteen other woodcuts delineate an allegorical exposition of the various

stages in the process of transmutation. A crowned king (gold) is approached by his son (mercury) and his five servants (silver, iron, lead, tin, and copper), who beseech him to change them into kings also. After passing through remarkable vicissitudes—representing alchemical operations and entailing, *inter alia*, his death and resurrection—the king is at last able to accede to their prayer, and the final woodcut shows a royal flush of crowned kings.

The allegorical and mystical aspects of alchemy became very prominent in the efflorescence of alchemical literature which appeared early in the seventeenth century, and reference may be made to some typical publications of this period. The *Amphitheatrum sapientiæ æternæ* of Heinrich Khunrath, printed at Hanover in 1609, is the most remarkable work of this devotee of theosophy and the wider occultism. Its curious cabbalistic plates depict the Smaragdine Table, the oratory-laboratory of Khunrath, the Alchemical Citadel, and other mystical and magical subjects, including, in the words of Caillet, "la planche qui représente Khunrath entouré de ses ennemis — cette planche étonnante qui est un véritable Callot, par anticipation." A smaller illustration, showing a bespectacled owl holding two torches and flanked by a pair of lighted candles, carries the dark saying, "What good are torches, light, or spectacles, to folk who won't see?"

> "Was helffen Fakeln Licht oder Briln,
> So die Leut nicht sehen wollen."

Waite states that "this German alchemist, who is claimed as a hierophant of the psychic side of the magnum opus, and who was undoubtedly aware of the larger issues of Hermetic theorems, must be classed as a follower of Paracelsus." The Alchemical Citadel is represented in a large double plate as a fortress guarded by a moat and surrounded by a maze of twenty-one sections. Of these, only one lends access across the moat; the other twenty carry

inscriptions showing the false activities of the worldly-minded alchemists—for example, the attempt to transmute ordinary mercury. The successful adept must be endowed with a knowledge of the material of the Great Work ; also with faith, silence, purity of heart, and prayerfulness. After passing through the gate surmounted by the hieroglyph of philosophic mercury he traverses the seven angles of the citadel, representing the seven transmutative operations of dissolution, purification, introduction into the sealed vessel, solution by putrefaction, multiplication, fermentation, and projection ; and even upon reaching the Petra Philosophalis he finds that it is held in the custody of a formidable dragon.

In a striking symbolical representation of the analogy of the alchemical microcosm to the macrocosm, occurring in the *Basilica Chymica* of Johann Daniel Mylius (Frankfurt, 1618), a still broader pictorial interpretation is given of the place of alchemy in the universe. Here, proceeding from " what is above " to " that which is below," we obtain a comprehensive view of " the miracles of one thing." First, comes the celestial world with the Tetragrammaton, or Name of the Lord, surrounded by angels. Next, appears the planetary and zodiacal world. This is followed by the terrestrial world, in the centre of which appears the terrestrial Paradise containing the seven metals and the alchemical principles. Below, on the left, is man, carrying the symbol of gold, the masculine principle ; on the right, woman, or silver, the feminine principle. Both these principles take part in the alchemical operation, and are bound to the macrocosm by chains. The formation of the world, the generation of metals, and the reproduction of man are held to be fundamentally similar.

The idea of masculine and feminine principles entering into the generation of the Philosopher's Stone and of metals and other inanimate materials is widely disseminated in alchemical literature. Thus, Norton, in the *Ordinall of*

Alchimy,[19] refers to "the faire White Woman married to the Ruddy Man," and Ripley [20] also writes of "the *Red Man* and hys *Whyte Wyfe*." Flamel [21] states more explicitly: "In the second operation thou hast two conjoined and married natures, the male and the female, and they are fashioned in one sole body, which is the androgyne of the ancients."

Part of the symbolical scheme of Mylius appears to find a reflection in a much simpler drawing occurring as a frontispiece to an alchemical manuscript in the St. Andrews collection. In the firmament above are shown the seven heavenly bodies radiating their influence upon the earth beneath, thereby, according to alchemical doctrine, favouring the generation of the corresponding metals; converging also upon the central crowned globe are emanations proceeding from a crowned eagle and lion, representing wind and earth, mercury and sulphur, or the volatile and fixed principles, respectively. The crowned globe symbolises the Philosopher's Stone, which was sometimes called the Great King. The mingled waters issuing from the mouths of three crowned lions carrying the symbols of mercury, salt, and sulphur give rise in the bowels of the earth to the seven metals, together with antimony and vitriol. The animation of the whole Work by the breath of the four elements is perhaps allusive to the Spirit of God moving upon the face of the waters in the creation of the world; for it has been stated [22] that "the first chapter of Genesis is the greatest page in alchemy."

Works attributed to Basil Valentine and certain other publications of the early seventeenth century appear to offer references to the Grail, that symbolical source of physical and spiritual life; others still, in particular the

[19] E. Ashmole, *op. cit.* p. 90.

[20] *Ibid.* p. 187.

[21] In *Le Livre des Figures Hieroglyphiques.*

[22] G. de Givry, *op. cit.* p. 350.

Atalanta Fugiens (1618) of Michael Maier and several associated works, are characterised by a crude anthropomorphosis linked with classical mythology.

All the works which have found mention in this brief review, and many others, have a definite interest to the modern student. It may be justly said, however, that a large proportion of alchemical literature is arid or unintelligible; some of the visionary writings, indeed, bear the marks of incipient lunacy. A general impression of this literature may be gained by an examination of such representative compilations as Zetzner's *Theatrum Chemicum* (six volumes, Strassburg, 1659) and Manget's *Bibliotheca Chemica Curiosa* (two volumes, Geneva, 1702); these two "omnibus" works afford also some idea of the enormous output of alchemical writings, for between them they contain a selection of more than three hundred tracts occupying nearly seven thousand pages.

The first volume of Manget's work contains a supplement of fifteen engraved plates, of folio size, entitled "Mutus Liber, in quo tamen tota Philosophia hermetica, figuris hieroglyphicis depingitur, ter optimo maximo Deo misericordi consecratus, solisque filiis artis dedicatus, authore cuius nomen est Altus." These enigmatic illustrations are not mentioned in the text, but they were apparently included as a symbolical and pictorial treatment of the various operations of the Great Work. Thus, the thirteenth plate depicts the introduction into the so-called aludel of equal weights of two fluids; the vessel, marked with the symbol of gold, is then hermetically sealed and transferred to the athanor, or furnace. The aludel has now become the sealed vase of Hermes, or philosophic egg, and here in the brooding furnace the Great Work is consummated. In the final episode, the two adepts, who are reminiscent of "the *Red Man* and hys *Whyte Wyfe*," Sol and Luna, have hit the target and achieved the Stone, whose transmuting power is perhaps indicated by the accompanying numbers.

An analysis of its literature shows that alchemy was a strange blend of logical thinking and mystical dreaming, of sound observation and wild superstition, of natural and moral ideas, and of objective facts and subjective conceptions. Nevertheless, the sympathetic student of the "divine Art" cannot but absorb something of the romance and wistfulness of alchemy's age-long struggle after the unattainable; nor can he remain unmindful of the immemorial traditions of alchemy's daughter, chemistry. At its best, alchemy was an earnest search after truth, in the light of that principle of the unity of matter which has been rediscovered by modern science. Is it too much to hope that time by degrees will bring forth a corresponding unity of heart which will act as an elixir of life in the regeneration of the nations?